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(54) **APPARATUS FOR INCONTINENCE  
DETECTION AND NOTIFICATION**

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**G08B 21/00** (2006.01)

(52) **U.S. Cl.** ..... **340/604**; 340/573.5; 340/605

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340/604, 605, 652

See application file for complete search history.

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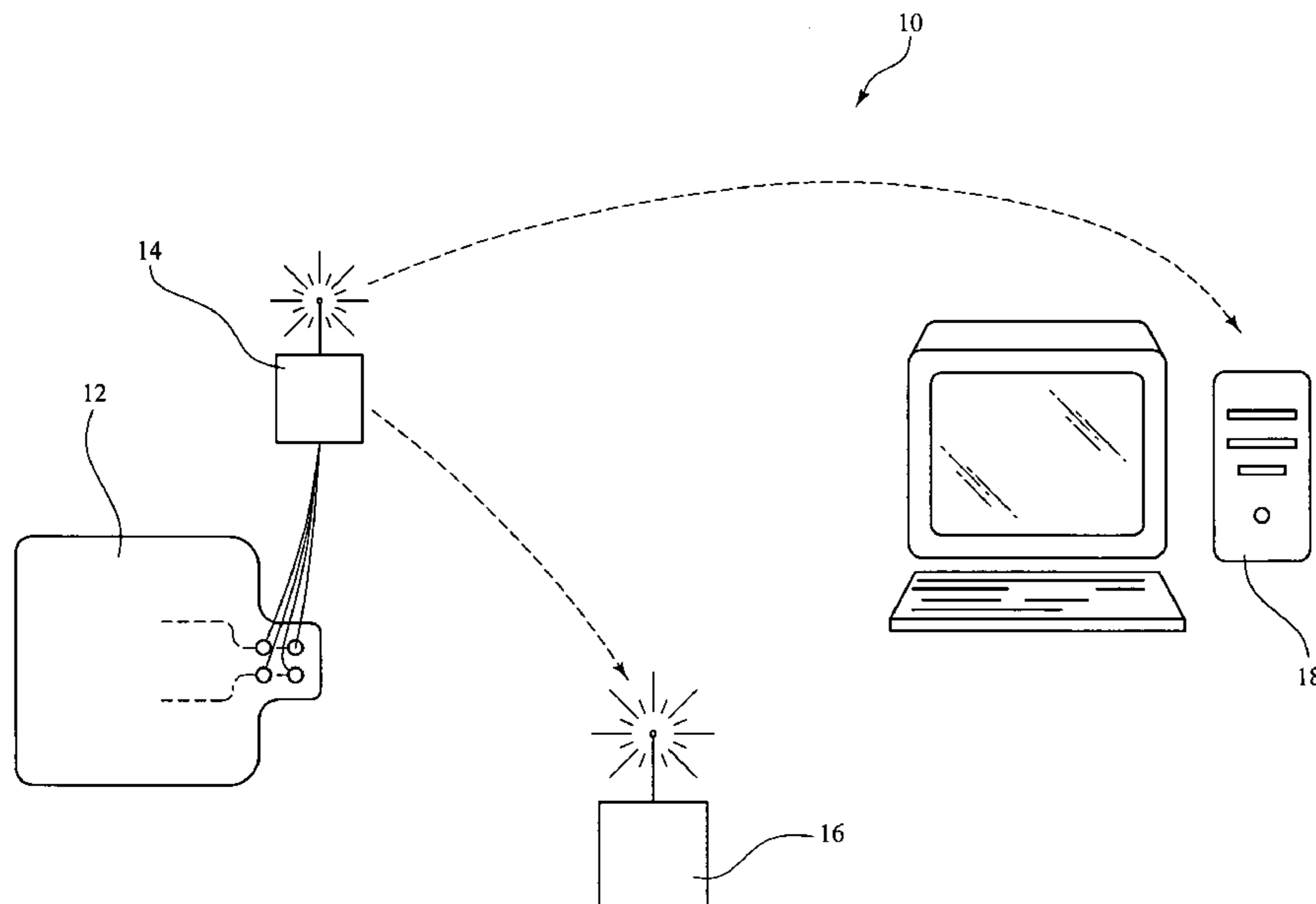
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(57) **ABSTRACT**

An apparatus for incontinence detection and notification  
comprises a notification component, for providing notice  
that an incontinent event has occurred, and a sensor. The  
sensor includes a sensing pad for collecting and retaining  
fluid resulting from the incontinent event, and a circuit  
housed within the sensing pad. The circuit has a pair of  
stainless steel electrodes, which are in electronic communi-  
cation with the notification component. A closed circuit is  
created between the electrodes by the fluid resulting from  
the incontinent event, causing an electronic signal to be  
communicated to the notification component. The circuit  
may also include a plurality of connectors placed in elec-  
tronic communication with the notification component to  
diagnose a disconnected or poorly connected circuit.

**13 Claims, 2 Drawing Sheets**



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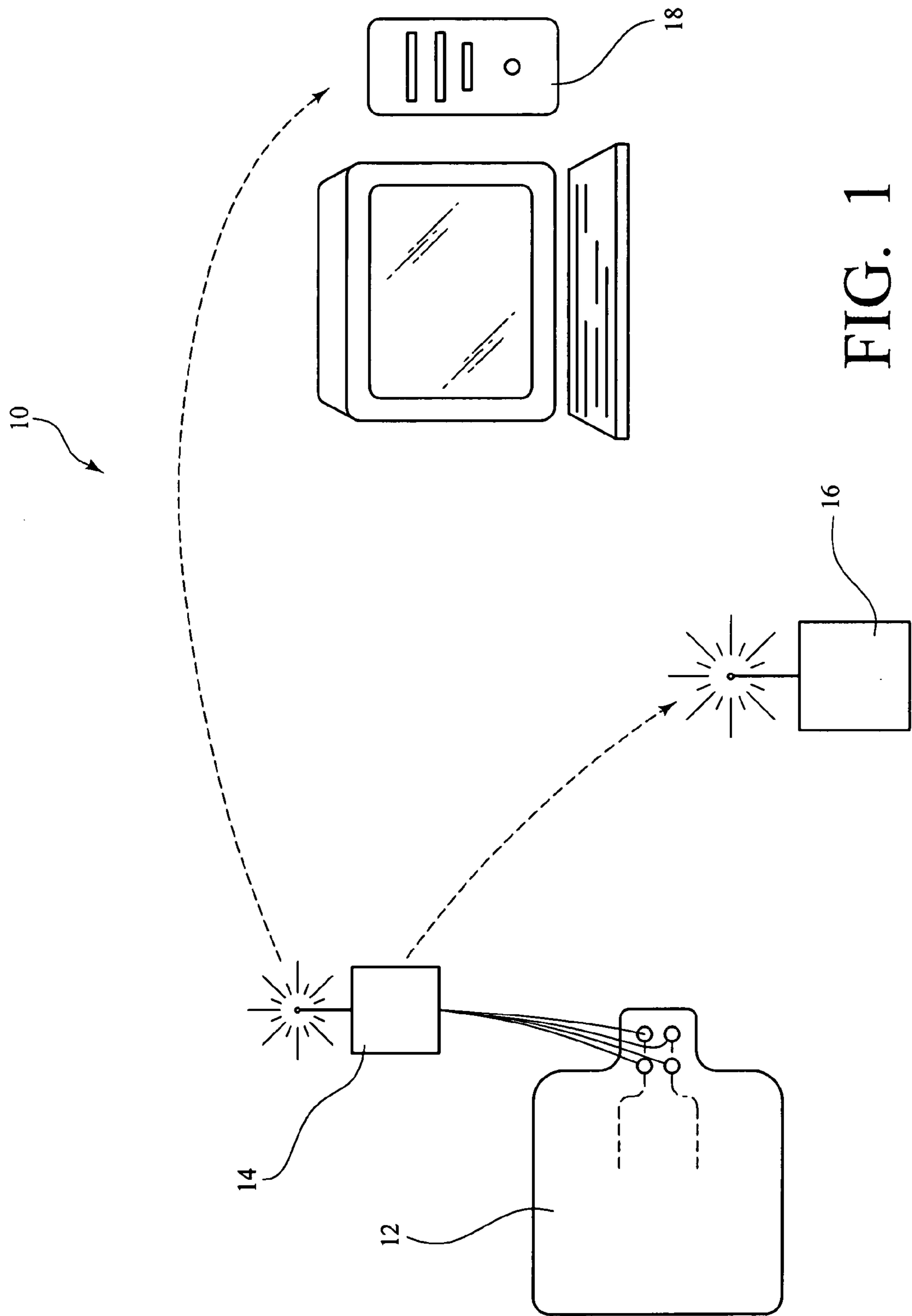


FIG. 1

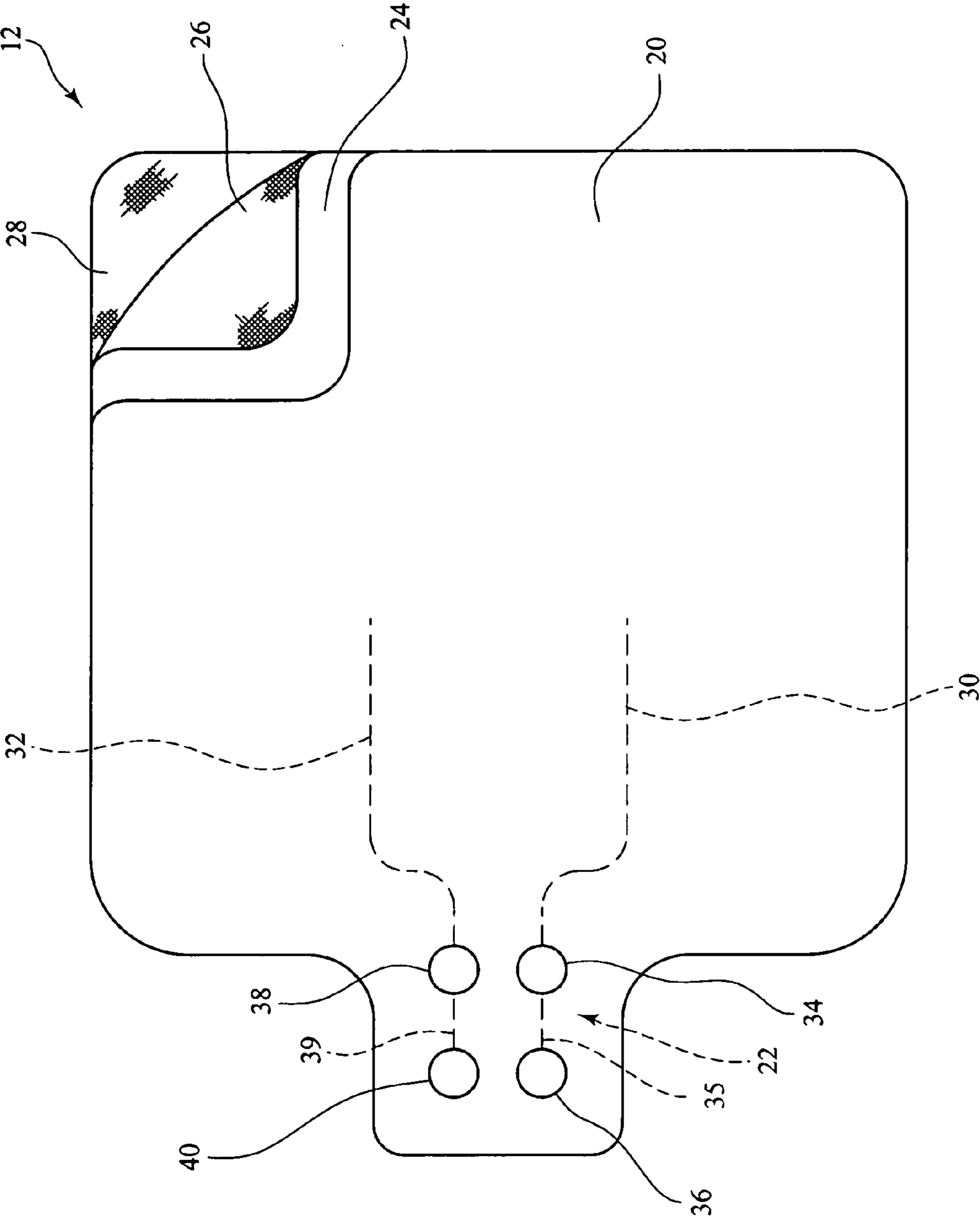


FIG. 2

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## APPARATUS FOR INCONTINENCE DETECTION AND NOTIFICATION

### CROSS REFERENCES TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 60/471,625 filed May 19, 2003, the entire disclosure of which is incorporated herein by this reference.

### FIELD OF THE INVENTION

The present invention relates to the detection of electrically conductive fluids, such as bodily fluids from human beings, including urine and feces.

### BACKGROUND OF THE INVENTION

In nursing homes and similar care facilities, resident incontinence is a prevalent problem. Failure to promptly respond to and assist incontinent residents after the occurrence of an incontinent event can result in infections, pressure ulcers, and other medical complications. Therefore, the nursing home and healthcare industry has sought to develop an effective apparatus for detecting the occurrence of incontinent events.

In this regard, apparatus have been pursued that include one or more sensors comprising a pair of electrodes connected with a voltage source, an audible alarm being activated when an electrically conductive fluid completes the circuit between the electrodes. However, such prior art apparatus are rife with problems. For example, many prior art sensors are not suitable for reuse because the sensors cannot withstand the heat and chemical treatments necessary for cleaning or sterilization. For another example, prior art apparatus do not allow for the detection of a disconnected or poorly connected circuit associated with the sensor.

Accordingly, there remains a need in the art for an apparatus for incontinence detection and notification that overcomes these problems.

### SUMMARY OF THE INVENTION

The present invention meets the above identified needs, and others, by providing an apparatus for incontinence detection and notification that can withstand rigorous heat and chemical cleaning such that the apparatus is reusable. The apparatus of the present invention also includes a sensor component that allows for the detection of a disconnected or poorly connected circuit. The apparatus of the present invention further provides for notification of an incontinent event through transmission of a signal to a remote receiver or monitoring station, along with the collection, storage, and analysis of data related to incontinent events.

An exemplary embodiment of the apparatus of the present invention includes a sensor for detecting the occurrence of an incontinent event and a notification component. The sensor generally comprises a washable multi-layered sensing pad with a detection circuit integrated therein, the detection circuit having a positive electrode and a negative electrode. The sensing pad is designed to be placed into contact with or worn by an individual. The electrodes may be constructed from a material, such as stainless steel, that is not only a conductor, but has the ability to withstand harsh heat and chemical treatments. As such, the entire sensor, including the sensing pad and the detection circuit, may be cleaned or sanitized and thereafter reused. When an incontinent event occurs, the resulting fluid is absorbed by the soaking pad, thereby creating a closed circuit between the positive electrode and the negative electrode and communicating to the notification component that an incontinent event has occurred.

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5 In addition to the electrodes, the detection circuit may include a pair of connectors associated with the positive electrode and a pair of connectors associated with the negative electrode. The connectors connect the detection circuit to the notification component. The connectors additionally allow for the detection of a disconnected or poorly connected circuit. In this regard, each pair of connectors is placed in electronic communication with one another using a jumper and a closed jumper circuit is formed therebetween. Accordingly, when the circuit becomes disconnected or poorly connected, one or both of the jumper circuits becomes opened. All four connectors are placed in electronic communication with the notification component; as such, the change between an opened and closed configuration of either jumper circuit causes an electronic signal to be communicated to the notification component.

### DESCRIPTION OF THE DRAWINGS

25 FIG. 1 is a schematic view of an exemplary embodiment of an apparatus made in accordance with the present invention; and

30 FIG. 2 is a plan view of the sensor of the exemplary embodiment depicted in FIG. 1.

### DESCRIPTION OF THE INVENTION

35 The present invention is an apparatus for incontinence detection and notification. With reference to FIG. 1, an exemplary embodiment of the apparatus 10 generally includes a sensor 12 for detecting the occurrence of an incontinent event, and a notification component 14, which is depicted as a wireless transmitter in FIG. 1. Furthermore, in this exemplary embodiment, the apparatus 10 includes a remote receiver or monitoring station 16 (e.g., pager or other wireless receiver) for receiving a notification of and/or data regarding the incontinent event from the notification component 14. Lastly, in this exemplary embodiment, the apparatus 10 includes an analysis component 18, such as computer and associated software, for collecting, storing, and analyzing data related to incontinent events.

40 Turning now to FIG. 2, the sensor 12 in this exemplary embodiment includes a washable multi-layered sensing pad 20 with a detection circuit 22 integrated therein, the detection circuit 22 having a pair of electrodes, one being positive 30 and the other being negative 32. The sensing pad 20 is designed to be placed into contact with or worn by an individual, much like a diaper or similar undergarment. In this exemplary embodiment, the sensing pad 20 is comprised of three distinct layers of material bonded together and housing the detection circuit 22. Specifically, the sensing pad 20 includes a first layer 24 of a washable material, such as polyester tricot, that contacts the wearer's skin. This first layer 24 is quilted or similarly joined to a second layer 26 of washable soaker material, which absorbs moisture in a manner similar to a diaper. The pair of electrodes 30, 32 are secured to this second layer 26. Finally, a third layer 28 of fluid-resistant material, such as vinyl, may be joined to the first two layers 24, 26, thereby enclosing the electrodes 22 within the sensing pad 20. This third layer 28 prevents moisture from escaping from the sensing pad 20.

The electrodes **30, 32** of the detection circuit **22** are constructed from a material, such as stainless steel, that is not only a conductor, but has the ability to withstand harsh heat and chemical treatments. For example, the electrodes **30, 32** may be constructed from Bekinox-VN12/4X275/100S stainless steel continuous filament yarn, which is manufactured and distributed by Bekaert Fiber Technologies of Research Triangle Park, N.C. As such, the entire sensor **12** may be cleaned or sanitized and thereafter reused. Alternatively, if the sensor **12** is to be disposable, and thus not subject to cleaning and sanitization, a less expensive metal conductor may be used.

An open circuit is maintained between the positive electrode **30** and the negative electrode **32**. When an incontinent event occurs, the resulting fluid is absorbed by the second layer **26** soaker material, thereby creating a closed circuit between the positive electrode **30** and the negative electrode **32**. Since the electrodes **30, 32** are placed in electric communication with the notification component **14**, the closing of the circuit is immediately communicated to the notification component **14**, as is further described below. Furthermore, it should be recognized that the electrodes **30, 32** are secured to the sensing pad **20** in a predetermined configuration because the distance between the electrodes **30, 32** determines the amount of fluid that has to be absorbed by the second layer **26** of soaker material before the circuit is completed. In other words, there is a correlation between the configuration of the electrodes **30, 32** and the sensitivity of the sensor **12**. Of course, although the electrodes **30, 32** are illustrated as being configured in two substantially parallel lines in this exemplary embodiment, various other configurations could be employed without departing from the spirit and scope of the present invention.

Although it is not necessary for the operation of the circuit in detecting incontinent events, in the depicted embodiment of the apparatus **10**, in addition to the electrodes **30, 32**, the detection circuit **22** includes a plurality of connectors **34, 36, 38, 40**, which allow for the physical and electrical connection of the circuit **22** to the notification component **14**. The connectors **34, 36, 38, 40** additionally allow for the detection of a disconnected or poorly connected circuit, as will be described further below. In this exemplary embodiment, the connectors **34, 36, 38, 40** are constructed from a material, such as stainless steel, and may be SW-30 series snaps manufactured by YKK Universal Fasteners, Inc. of Lawrenceburg, Ky.

Specifically, with reference to FIG. 2, the circuit **22** includes a first and a second connector **34, 36** associated with the positive electrode **30** and a third and a fourth connector **38, 40** associated with the negative electrode **32**. The distal end of the positive electrode **30** is placed in electronic communication with the first connector **34**, while the distal end of the negative electrode **32** is placed in electronic communication with the third connector **38**. The first connector **34** is additionally placed in electronic communication with the second connector **36** using a jumper **35**, while the third connector **38** is additionally placed in electronic communication with the fourth connector **40** using a jumper **39**. As such, a closed jumper circuit is created between the first and second connectors **34, 36**, and a similar jumper circuit is created between the third and fourth connectors **38, 40**. Like the electrodes, the jumpers **35, 39** are constructed from a material that is not only a conductor, but also has the ability to withstand harsh heat and chemical treatments, for example, Bekinox-VN12/4X275/100S stain-

less steel continuous filament yarn, which is manufactured and distributed by Bekaert Fiber Technologies of Research Triangle Park, N.C.

Accordingly, the notification component **14** not only monitors the open circuit between the electrodes **30, 32**, but also monitors the closed jumper circuits. When an electrically conductive fluid absorbed into the second layer **26** of soaker material has closed the circuit between the electrodes **30, 32**, that change is communicated to the notification component **14**. Likewise, when the detection circuit **22** becomes disconnected or poorly connected, the jumper circuit between either the first and second connectors **34, 36** or the third and fourth connectors **38, 40** becomes opened. This change in either jumper circuit also causes an electronic signal to be communicated to the notification component **14**. For example, if any of the four connectors **34, 36, 38, 40** become disconnected, perhaps during cleaning and sanitization, there will be an open circuit condition communicated to the notification component **14**, indicating that the sensor **12** can not function.

In the depicted embodiment, the notification component **14** is a wireless transmitter; however, it could be a visible or audible alarm or similar device without departing from the spirit and scope of the present invention. In any event, it is contemplated that the notification component **14** is designed to be waterproof and includes a battery or similar power source for powering the detection circuit **22**. Once an electrically conductive fluid absorbed into the second layer **26** of soaker material has closed the circuit, the wireless transmitter **14** is activated to notify a remote receiver or monitoring station **16**. This allows a caregiver to immediately respond and provide appropriate care for the incontinent individual. Furthermore, signals from multiple sensors may be received and identified by the remote monitoring station **16**, thereby allowing for more effective scheduling of rounds by the caregivers.

Finally as mentioned above, the notification component **14** (e.g., wireless transmitter) may be capable of transmitting information to an analysis component **18**, such as computer and associated software, for collecting, storing, and analyzing data related to incontinent events.

It will be obvious to those skilled in the art that further modifications may be made to the embodiments described herein without departing from the spirit and scope of the present invention.

What is claimed is:

1. An apparatus for incontinence detection and notification, comprising:
  - a notification component for providing notice that an incontinent event has occurred; and
  - a washable sensor, including
    - a sensing pad for collecting and retaining fluid resulting from the incontinent event, said sensing pad including a first layer of a washable material for contacting the skin of a wearer, a second layer of washable soaker material for absorbing the fluid resulting from the incontinent event, and a third layer of fluid-resistant material joined to said first and second layers, said third layer preventing fluid from escaping from the sensing pad, and
    - a circuit integrated within the second layer of said sensing pad having a first and a second electrode, a closed circuit being created between said electrodes by the fluid resulting from the incontinent event, causing an electronic signal to be communicated to the notification component;

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wherein said electrodes are constructed from a material having the ability to withstand harsh heat and chemical treatments, such that said sensor, including the sensing pad and integrated circuit, may be cleaned, sanitized, and thereafter reused.

2. The apparatus as recited in claim 1, wherein the notification component is a transmitter.

3. The apparatus as recited in claim 2, and further comprising a remote receiver for receiving a notification of and/or data regarding the incontinent event from the notification component.

4. The apparatus as recited in claim 3, and further comprising an analysis component receiving information from the notification component for collecting, storing, and analyzing data related to incontinent events.

5. The apparatus as recited in claim 2, and further comprising an analysis component receiving information from the notification component for collecting, storing, and analyzing data related to incontinent events.

6. The apparatus as recited in claim 1, wherein said electrodes are constructed from stainless steel.

7. The apparatus as recited in claim 6, wherein said electrodes are constructed from a stainless steel continuous filament yarn.

8. An apparatus for incontinence detection and notification, comprising:

a notification component for providing notice that an incontinent event has occurred; and

a sensor, including

a sensing pad for collecting and retaining fluid resulting from the incontinent event, and

a circuit housed within the sensing pad having a first and a second electrode, a closed circuit being created between said electrodes by the fluid resulting from the incontinent event, causing an electronic signal to be communicated to the notification component, the circuit further including

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a first connector placed in electronic communication with the first electrode;

a second connector placed in electronic communication with the first connector;

a third connector placed in electronic communication with the second electrode; and

a fourth connector placed in electronic communication with the third connector,

wherein a closed circuit is created between the first and second connectors and another closed circuit is created between the third and fourth connectors, and all connectors are placed in electronic communication with the notification component, an electronic signal being communicated to the notification component upon the formation of an open circuit between the connectors, indicating that the sensor can not function.

9. The apparatus as recited in claim 8, wherein the notification component is a transmitter.

10. The apparatus as recited in claim 9, and further comprising a remote receiver for receiving a notification of and/or data regarding the incontinent event from the notification component.

11. The apparatus as recited in claim 10, and further comprising an analysis component receiving information from the notification component for collecting, storing, and analyzing data related to incontinent events.

12. The apparatus as recited in claim 9, and further comprising an analysis component receiving information from the notification component for collecting, storing, and analyzing data related to incontinent events.

13. The apparatus as recited in claim 8, wherein the electrodes are constructed from stainless steel.

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